Gulf Cooperation Council

EDICT OF GOVERNMENT

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GSO 62 (1987) (English): INDUSTRIAL SAFETY AND HEALTH REGULATIONS – HAZARDOUS MATERIALS - FLAMMABLE AND COMBUSTIBLE LIQUIDS PART 1: TANKS, PIPING AND ACCESSORIES

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اشتراطات السلامة والصحة الصناعية
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INDUSTRIAL SAFETY AND HEALTH REGULATIONS – HAZARDOUS MATERIALS - FLAMMABLE AND COMBUSTIBLE LIQUIDS -PART 1: TANKS, PIPING AND ACCESSORIES

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INDUSTRIAL SAFETY AND HEALTH REGULATIONS – HAZARDOUS MATERIALS - FLAMMABLE AND COMBUSTIBLE LIQUIDS- PART 1: TANKS, PIPING AND ACCESSORIES

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CONTENT

INDUSTRIAL SAFETY AND HEALTH REGULATIONS – HAZARDOUS MATERIALS - FLAMMABLE AND COMBUSTIBLE LIQUIDS PART 1: TANKS, PIPING AND ACCESSORIES

1. SCOPE AND FIELD OF APPLICATION

This Standard is concerned with the design and construction of tanks from steel or non-combustible material other than steel for flammable and combustible liquids with a flash point below 93'C. It is also concerned with piping, valves and accessories used with these tanks.

This Standard is not applicable to liquids without flash points, that may be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons.

2. COMPLEMENTARY REFERENCES

2.1 GSO 63/1987 concerned with "Industrial Safety and Health Regulations - Equipment - Tanks, Pressure Vessels, Boilers and Compressed Gas Equipment",

2.2 GSO 64/1987 "Industrial Safety and Health Regulations - Hazardous Materials - Flammable and Combustible Liquids - Part 2: Container and Portable Tank Storage".

2.3 GSO 65/1987 "Industrial Safety and Health Regulations - Hazardous Materials - Flammable and Combustible Liquids - Part 3: Industrial and Bulk Plants".

2.4 GSO 215/1994 "Industrial Safety and Health Regulations - Hazardous Materials - Flammable and Combustible Liquids - Part 4: 'Service Stations, Processing Plants, Refineries and Chemical Plants".

3. DEFINITIONS

3.1 Atmospheric Tank: A tank which has been designed to operate at pressures from 0. through 3.530 kPa.

3.2 Combustible Liquid: A liquid having a flash point at or above 37.8^{o}C. Combustible liquids shall be divided into two classes as follows:

3.2.1 Class 2 Liquids: Liquids with flash points at or above 37.8^{o}C and below 60^{o}C.

3.2.2 Class 3 A Liquids: Liquids with flash points at or above 60'C and below 93^{o}C.

3.2.3 Class 3 B Liquids: Liquids with flash points at or above 93^{o}C.

When a combustible liquid is heated for use within 16.7^{o}C of its flash point, it shall be handled in accordance with the requirements for the next lower class of liquids.

3.3 Flammable Liquid A liquid having a flash point below 37.50°C. Flammable liquids shall be known as Class 1 liquids. Class 1 liquids are divided into three classes as follows: Class IA shall include liquids having flash points below 22.8°C and a boiling point below 37.8°C. Class IB shall include liquids having flash points below 22.8°C and a boiling point at or above 37.8°C. Class IC shall include liquids having flash points at or above 22.8°C and below 37.8°C.

3.4 Flash Point: Minimum temperature at which a liquid gives off vapour within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

3.5 Low-Pressure Tank: Tank which has been designed to operate at pressures above 3.5 kPa but not more than 103.4 kPa.

3.6 Protected: Protected by a fire protection system.

4. REGULATIONS

4.1 Tanks

4.1.1 Design and Construction of Tanks

4.1.1.1 Tanks shall be built of steel except as provided in the following items.

4.1.1.1.1 Tanks may be built of materials other than steel for installation underground or if required by the properties of the liquid stored. Tanks 1Qcated above ground or inside buildings shall be of noncombustible construction.

4.1.1.1.2 Tanks built of materials other than steel shall be designed to specifications embodying principles recognized as good engineering design for the material used.

4.1.1.1.3 Unline concrete tanks may be used for storing flammable or combustible liquids having a specific gravity of .83 or heavier. Concrete tanks with special lining may be used for other services provided the design is in accordance with sound engineering practice.

4.1.1.2 Tanks and pressure vessels shall be designed according to the Gulf Standard mentioned in item 2.1. Normal operating pressure of tanks shall not exceed design pressure.

4.1.1.3 Atmospheric tanks shall not be used for the storage of a flammable or combustible liquid at a temperature at or above its boiling point.

4.1.2 Spacing (Shell-to-Shell) between Aboveground Tanks

4.1.2.1 The distance between any two adjacent tanks shall not be less than one-sixth the sum of their diameters, except as provided in item 4.1.2.3. When the diameter of one tank is less than onehalf the diameter of the adjacent tank, the distance between the two tanks shall not be less than one-half the diameter of the smaller tank. In no case shall the distance be less than 1 m.

4.1.2.2 Where crude petroleum in conjunction with production facilities are located in noncongested areas and have capacities not exceeding 477 cu m (3,000 barrels), the distance between such tanks shall not be less than 1 m.

4.1.2.3 The distance between tanks where unstable flammable or combustible liquids are stored shall not be less than one-half the sum of their diameters.

4.1.2.4 The minimum separation between a liquefied petroleum gas container and a flammable or combustible liquid storage tank be 6.1 m except in the case of flammable or combustible liquid tanks operating at pressures exceeding 17.26 kPa or equipped with emergency venting which will permit pressures to exceed 17.26 kPa in which case the provisions of items 4.1.2.1 and 4.1.2.2 shall apply. Suitable means shall be taken to prevent the accumulation of flammable or combustible liquids under adjacent liquefied petroleum gas containers such as by diversion curbs or grading. The foregoing provisions shall not apply when liquefied petroleum gas containers of .5 cu m or less capacity are installed adjacent to fuel oil supply tanks of 2 cu m or less capacity.

4.1.3 Emergency Relief Venting for Fire Exposure for Aboveground Tanks

4.1.3.1 Every aboveground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires.

4.1.3.2 In a vertical tank the construction referred to in item above may take the form of a floating roof, lifter roof, a weak roof-to-shell seam or other approved pressure relieving construction.

4.1.3.3 Where entire dependence for emergency relief is placed upon pressure relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 1 except as provided in items 4.1.3.5 and 4.1.3.6. Such device may be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or larger relief valve or valves. The wetted area of the tank shall be calculated on the basis of 55 percent of the total exposed area of a sphere or spheroid, 75 percent of the total exposed area of a horizontal tank and the first 9.1 m above grade of the exposed shell area of a vertical tank.

Table 1

Wetted Area Versus Cubic Meters Free Air Per Hour

(101.3 kPa and 16°C).

Square Meters	Cubic Meters/ Hour	Square Meters	Cubic Meters/ Hour
2	640	60	11600
4	1280	70	12650
6	1930	80	13640
8	2570	90	14580
10	3200	100	15370
12	3840	110	15720
14	4490	120	16190
16	5140	130	16640
18	5800	150	17470
20	6350	170	18220
30	7810	180	18570
40	9200	200	19240
50	10460	260	21000

4.1.3.4 For tanks and storage vessels designed for pressure over 6.864 kPa the total rate of venting shall be determined in accordance with Table 1, except that when the exposed wetted area of the surface is greater than 260 sq m, the total rate of venting shall be calculated by the following formula:

$$\text{cu m/hr} = 3632A^{(.82)}$$

Where:

cu m/hr = Venting requirement, in cu m of free air/hr.

A = Exposed wetted surface in sq m.

4.1.3.5 The total emergency relief venting capacity for any specific stable liquid may be determined by the following formula:

$$V = \frac{20.3}{L\sqrt{M}}$$

V = Cu m of free air/hr from Table 4.2-1

L = Latent heat of vaporization of specific liquid in joules/kg.

M = Molecular weight of specific liquids.

4.1.3.6 The required airflow rate of item 4.1.3.3 or 4.1.3.5 may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only 1 factor may be used for any 1 tank.

0.3 for approved water spray

0.3 for approved insulation

0.15 for approved water spray with approved insulation.

4.1.3.7 The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 17.26 kPa shall be arranged to discharge in such a way as to prevent localized overheating of any part of the tank, in the event vapours from such vents are ignited.

4.1.3.8 Each commercial tank venting device shall have the opening pressure, stamped on it, the pressure at which the valve reaches the full open position, and the flow capacity at the latter pressure, expressed in cu m/hr of air at 16^{o}C and at a pressure of 101.3 kPa.

4.1.3.9 The flow capacity of tank venting devices 20 cm and smaller in pipe size shall be determined by actual test of each type and size of vent. These flow tests may be conducted by the manufacturer if certified by a qualified impartial observer, or may be conducted by an outside agency. The flow capacity of tank venting devices larger than 20 cm pipe size, including manhole covers with long bolts or equivalent, may be calculated provided that the openings pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the work “Calculated” appears on the nameplate, and the computation is based on a flow coefficient of nameplate, and the computation is based on a flow coefficient of 0.5 applied to the rated orifice area.

4.2.3.4 Vent Piping for Underground Tanks

4.1.4.1 Where vent pipe outlets for tanks storing Class 1 liquids are adjacent to buildings or public ways, they shall be located so that the vapours are released at a safe point outside of buildings and not less than 3.6 m above the adjacent ground level. Vapours shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapours will not be trapped by eaves or other obstructions and shall be at least 1.5 m from building openings.

4.1.4.2 When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapours they may be required to handle when manifolded tanks are subject to the same fire exposure.

4.1.5 Tank Openings other than Vents for Aboveground Tanks

4.1.5.1 Connections for all tank openings shall be vapourtight and liquidtight.

4.1.5.2 Each connection to an aboveground tank through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel.

4.1.5.3 Each connection below the liquid level through which liquid does not normally flow shall be provided with a liquidtight closure. This may be a valve, plug, or blind, or a combination of these.

4.1.5.4 For Class I B and Class I C liquids other than crude oils, gasolines, and asphalts, the fill pipe shall be designed and installed to minimize the possibility of generating static electricity. A fill pipe entering the top of a tank shall terminate within 15 cm of the bottom of the tank and shall be installed to avoid excessive vibration.

4.1.5.5 Filling and emptying connections which are made and broken shall be locked outside of buildings at a location free from any source of ignition and not less than 1.5 m away from any building opening. Such connection shall be closed and liquidtight when not in use. The connection shall be properly identified.

4. i.6 installation of Underground Tanks

4.1.6.1 Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank . The distance from any part of a tank storing Class 1, 2 or 3 liquids to the nearest wall of any basement or pit shall be not less than 30 cm and to any property line that may be built upon not less than 1 m.

4.1.6.2 Underground tanks shall be set on firm foundations and surrounded with at least 15 cm of noncorrosive, inert materials such as clean sand, earth, or gravel well tamped in place. The tank shall be placed in the hole with care since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank, or scrape off the protective coating of coated tanks.

Tanks shall be covered with a minimum of 60 cm of earth, or shall be covered with not less than 30 cm of earth, on top of which a slab or reinforced concrete not less than 10 cm thick shall be placed. When underground tanks are, or are likely to be, subject to traffic, they shall be protected against damage from vehicles passing over them by at least 90 cm of earth cover or 46 cm of well-tamped earth, plus 15 cm of reinforced concrete or 20 cm of asphaltic concrete.

When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least 30 cm horizontally beyond the outline of the tank in all directions.

4.1.6.3 Vents

4.1.6.3.1 Vent pipes from tanks storing Class 1 liquids shall be so located that the discharge point is outside of buildings, higher than the fill Pipe opening, and not less than 3.6 m above the adjacent ground level. Vent pipes shall discharge only upward in order to disperse vapours. Vent pipes 5 cm or less in inside diameter shall not be obstructed by devices that will cause excessive back pressure. Vent pipe outlets shall be so located that flammable vapours will not enter building openings, or be trapped under eaves or other obstructions. If the vent pipe is less than 3 m in length, or greater than 5 cm in inside diameter, the outlet shall be provided with a

vacuum and pressure relief device or there shall be an approved flame arrester located in the vent line at the outlet.

4.1.6.3.2 Each tank shall be vented through piping adequate in size to prevent blow-back of vapour or liquid at the fill opening while the tank is being filled. Vent pipes shall be not less than 32 mm inside diameter.

4.1.6.3.3 Vent pipes from tanks storing Class 2 or Class 3 flammable liquids shall terminate outside of the building and higher than the fill pipe opening. They may be fitted with return bends, coarse screens or other devices to minimize ingress or foreign material.

4.1.6.3.4 Vent piping shall be constructed in accordance with item 4.2. Vent pipes shall be so laid as to drain toward the tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage. The tank end of the vent pipe shall enter the tank through the top.

4.1.6.3.5 When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapours they may be required to handle when manifolded tanks are filled simultaneously.

4.1.6.4 Openings for manual gauging, if independent of the fill pipe, shall be provided with a liquidtight cap or cover. If inside a building, each such opening shall be protected against liquid overflow and possible vapour release by means of a spring loaded check valve or other device. Fill and discharge lines shall enter tanks only through the top. Fill lines shall be sloped toward the tank.

4.1.7 Installation of Tanks Inside Buildings

4.1.7.1 Tanks shall not be permitted inside buildings except as provided in the Gulf Standards mentioned in items 2.3 and 2.4.

4.1.7.2 Vents for tanks inside buildings shall be as provided in the Gulf Standard mentioned in item 2. 1, item 4.1.3 and item 4.2.3.3, except that emergency venting by the use of weak roof seams on tanks shall not be permitted. Vents shall discharge vapours outside the buildings.

4.1.7.3 Vent piping shall be constructed in accordance with item 4.2.

4.1.7.4 Tank Openings other than Vents

4.1.7.4.1 Each connection to a tank inside of buildings through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel.

4.1.7.4.2 Flammable or combustible liquid tanks located inside buildings, except in one-story buildings designed and protected for flammable or combustible liquid storage, shall be provided with an automatic closing heat-actuated valve on each 'Withdrawal connection below the liquid level, except for connections used for emergency disposal, to prevent continued flow in the event of fire. This function may be incorporated in the valve required in item 4.1.7.4.1 and if a separate valve, shall be located adjacent to the valve required.

4.1.7.4.3 Openings for manual gauging, if independent of the fill pipe, shall be provided with a vapourtight cap or cover. Each such opening shall be protected against liquid overflow and possible vapour release by means of a spring loaded check valve or other approved device.

4.1.7.4.4 The inlet of the fill pipe shall be located outside of buildings at a location free from any source of ignition and not less than 1.5 m away from any building opening. The inlet of the fill pipe shall be closed when not in use. The fill connection shall be properly identified.

4.1.7.4.5 Tanks inside buildings shall be equipped with a device, or provided with, other means, to prevent overflow into the building.

4.1.8 Supports and Foundations for all Tank Locations

4.1.8.1 Steel supports or exposed piling shall be protected by materials having a fire resistance rating of not less than two hours, except that steel saddles need not be protected if they are less than 30 cm high at their lowest point. Water spray protection or its equivalent may be used in lieu of fire-resistive materials to protect supports.

4.1.8.2 Tanks shall rest on the ground or on foundations made of concrete, masonry, piling, or steel.

4.1.9 The area surrounding a tank or a group of tanks shall be provided with drainage as in item 4.1.9.1 or shall be diked as provided in item 4.1.9.2.

4.1.9.1 Drainage

Where protection is by means of a natural or man-made drainage system, such systems shall comply with the following:

4.1.9.1.1 A slope of not less than 1 percent away from the tank toward the drainage system shall be provided.

4.1.9.1.2 The drainage system shall terminate in vacant land or other area or in an impounding basin having a capacity not smaller than that of the largest tank served. This termination area and the route of the drainage system shall be so located that, if the liquids in the drainage system are ignited, the fire will not seriously expose tanks, buildings or personnel.

4.1.9.1.3 The drainage system, including automatic drainage pumps, shall not discharge to adjoining property, natural water courses, public sewers, or public drains unless the discharge of liquids would not constitute a hazard, or the system is so designed that it will not permit flammable or combustible liquids to be released.

4.1.9.2 Diked Areas Where protection is accomplished by retaining the liquid around the tank by means of a dike, the volume of the diked area shall comply with the following requirements:

4.1.9.2.1 The volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. The capacity of the diked area enclosing more than one tank shall be calculated by deducting the volume of the tanks other than the largest tank below the height of the dike.

4.2.9.2.2 Walls of the diked area shall be of earth, steel, concrete or solid masonry designed to be liquidtight and to withstand a full hydrostatic head. Earthen walls 1 m or more in height shall have a flat section at the top not less than 60 cm wide.

4.1.9.2.3 The walls of the diked area shall be restricted to an average height of 1.8 m above interior grade.

4.1.9.2.4 Where provision is made for draining water from diked areas, drainage shall be provided at a uniform slope of not less than 1 percent away from tanks toward a sump, drainbox, or other safe means of disposal located at the greatest practical distance from the tank. Such drains shall normally be controlled in a manner that prevents flammable or combustible liquids from entering natural water courses, public sewers, or public drains, their presence would constitute a hazard. Control drainage shall be accessible under fire conditions.

4.1.9.2.5 No loose combustible material, empty or full drum or barrel, shall be permitted within the diked area.

4.1.9.2.6 Each diked area containing two or more tanks shall be subdivided preferably by drainage channels or at least by intermediate curbs in order to prevent spills from endangering adjacent tanks within the diked areas as follows.

4.1.9.2.6.1 When storing normally stable liquids in vertical cone roof tanks constructed with weak roof-to-shell seam or approved floating roof tanks or when storing crude petroleum in producing areas in any type of tank, one subdivision for each tank in excess of 1590 cu m and one subdivision for each group of tanks (no tank exceeding 1590 cu m capacity) having an aggregate capacity not exceeding 2380 cu m.

4.1.9.2.6.2 When storing normally stable flammable or combustible liquids in tanks not covered in item 4.1.9.2.6. 1, one subdivision for each tank in excess of 380 cu m and one subdivision for each group of tanks (no tank exceeding 380 cu m capacity) having an aggregate capacity not exceeding 570 cu m.

4.1.9.2.6.3 When storing unstable liquids in any type of tank, one subdivision for each tank.

4.1.9.2.6.4 The drainage channels or intermediate curbs shall be located between tanks so as to take full advantage of the available space with due regard for the individual tank capacities. Intermediate curbs, where used, shall be not less than 50 em in height.

4.1.9.2.7 At least one means of safe access shall be provided over retaining walls to the area within the walls. When the walls exceed 1 m in height, access shall be provided by means of a stairway, walkway, or ramp. The means of access may also serve as a means of exit.

4.1.9.2.7.1 Where dike walls exceed 1 m in height, there shall be provided at least one emergency exit located as nearly opposite the means of access as possible. The emergency exit shall be a stairway, walkway, fixed ladder or ramp.

4.1.9.2.7.2 Walkways and ramps may be structures of metal or wood, or, in the case of earthen retaining walls with sloping embankments, they may be suitable surfaced natural walkways or ramps on the embankment, in which case the slope of the walkway or ramp shall not exceed 20 degrees with the horizontal.

4.1.9.2.7.3 Structural walkways or ramps shall have a slope of less than 20 degrees with the horizontal and, if the slope exceeds 1:6, shall have securely attached and uniformly spaced cleats, not over 30 cm apart, or other equally effective nonslip provisions.

4.1.9.2.8 Diversion walls and retaining walls shall not have roadway or walkway openings except temporary openings for equipment during repairs.

4.1.9.2.9 There shall be no unnecessary openings or holes in diversion or retaining walls. Pipe line openings shall have a diameter not greater than necessary to permit the movement of the pipe.

4.1.10 Sources of Ignition

In locations where flammable vapours may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, and mechanical), spontaneous ignition, chemical and physical-chemical reactions, and radiant heat. See the Gulf Standard mentioned in item 2.2.

4.2 Piping, Valves and Fittings

4.2.1 The design (including selection of materials) fabrication, assembly, test and inspection of piping systems containing flammable or combustible liquids shall be suitable for the expected working pressures, structural stresses and in compliance with good engineering practices.

4.2.2 Pipe lines containing flammable, corrosive, or toxic liquids or gases shall be identified to indicate their contents or purpose when such identification is practical and the correct operation of the valves of the line is essential to the safety of employees. The identification of the line shall be by name or colour placed on the lines or on the valves in the lines and shall be legible from the place at which the valves are operated. This shall not prohibit identification by the use of both a name and a colour. Identifications shall be maintained so as to be legible.

4.2.3 Materials for Piping, Valves, and Fittings

4.2.3.1 Materials for piping, valves, or fittings shall be steel, nodular iron, or malleable iron, except as provided below.

4.2.3.2 Exceptions. Materials other tha n steel, nodular iron, or malleable iron may be used underground,of the flammable or corfibustible liquid handled.

4.2.3.3 When low-melting such as aluminium and brass or materials such as cast iron, are necessary, special consideration shall be given to their behaviour on fire exposure. If such materials are used in aboveground piping systems or inside buildings, they shall be suitably protected against fire exposure or so located that any spill resulting from the failure of these materials could not unduly expose persons, buildings or structures or can be readily controlled by remote valves.

4.2.4 Joints shall be made liquid tight. Welded or screwed or approved connectors shall be used. Threaded joints and connections shall be made tight with a suitable lubricant or piping compound. Pipe joints dependent upon the friction

characteristics of combustible materials for mechanical continuity of piping shall not be used inside buildings above or below ground. If used above ground, the piping shall wither be secured to prevent disengagement at the fitting or the piping system shall be so designed that any spill resulting from such disengagement could not unduly expose persons, important buildings or structures, and could be readily controlled by remote valves

4.2.5 Pipe systems shall be supported and protected against physical damage and excessive stresses arising from settlement. vibration, expansion, or contraction.

4.2.6 All piping for flammable or combustible liquids, both aboveground and underground, where subject to external corrosion, shall be painted or otherwise protected.

4.2.7 Piping systems shall contain a sufficient number of valves to operate the system properly. Piping systems in connection with pumps shall contain a sufficient number of valves to control properly the flow of liquid in normal operation and in the event of physical damage. Each connection to pipelines, by which equipment such as tankcars or tank vehicles discharge tanks, shall be provided with a check valve for liquids by means of pumps into storage room the automatic protection against blackflow if the piping arrangement is such backflow from the system is possible.

4.2.8 All piping before being placed in use shall be hydrostatically tested to 150 percent of the maximum anticipated pressure of the system, or pneumatically tested to 110 percent of the maximum anticipated pressure of the system, but not less than 34.325 kPa at the highest point of the system. This test shall be maintained for a sufficient time to complete visual inspection of all joints and connections.